VERIFICATION OF THE TRANSLATION

I, the below-named Chartered Patent Attorney of Tokyo Japan having an office at an address stated below, hereby declare that :

I am knowledgeable in the English and Japanese languages, and I believe that the attached English translation of the Japanese Patent Application No. 2002-326019 filed on November 8, 2002 is a true and complete translation of said application.

I also hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true ; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date : March 17, 2008

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Japanese patent application No. 2002-326019

[Kind of Document] Application for Patent

[Reference Number] 2002093008

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[Description of Official Fee]

[Prepayment Ledger No.] 000136

[Official Fee paid] ¥21,000

[List of Attached Document]

[Kind of Document] Specification

[Kind of Document] Drawings

[Kind of Document] Abstract

[Proofreading] required

[Kind of Document] SPECIFICATION

[Title of the present invention]
ELECTROLYTIC CAPACITOR

[Claims]
[Claim 1]

An electrolytic capacitor provide with a capacitor element formed by winding an anode electrode foil, a cathode electrode foil and a separator and by impregnating them with an electrolytic solution and an outer case housing the capacitor element and a sealing member housing an opening of the outer case, wherein an electrolytic solution containing an aluminum tetrafluoride salt is used as the electrolytic solution, and wherein a sealing member, a partial cross-linking peroxide butyl rubber that added peroxide as cross-linking agent to a butyl rubber polymer comprised of isobutylene, isoprene, and divinylbenzene copolymer.

[Detailed Description of the Invention]
[0001]
[Industrial Application]

The present invention relates to an electrolytic capacitor, especially the electrolytic capacitor having a low impedance characteristic and a high withstand voltage characteristic.

[0002]

[Description of the Prior Art]

An electrolytic capacitor generally consists of structure as shown in Fig. 1. Namely, it has an anode electrode foil 2 made of a band-shaped high purity aluminum foil where the effective aluminum foil surface has been enlarged through etching process chemically or electrochemically, and an oxide film is formed on the surface, through a chemical process of treating the aluminum foil with a chemical solution such as ammonium borate aqueous solution and the like. A cathode electrode foil 3 is also made of an etched aluminum foil of high purity. Capacitor element 1 is formed by the anode electrode foil 2 and the cathode electrode foil 3, wound together with intervening separator 11 made of manila paper and the like. Next, the capacitor element 1, after impregnating with an electrolyte solution for driving the electrolytic capacitors, is housed into a bottomed outer case 10 made of aluminum and the like. The outer case 10 is equipped at the opening with a sealing member 9 made of an elastic rubber, and is sealed by drawing.

[0003]

As shown in Fig. 2, the anode electrode foil 2 and the cathode electrode foil 3 are connected respectively to lead wires 4 and 5 for leading these electrodes by means of stitching, ultrasonic welding, and the like. The lead wires 4 and 5 which are for leading these electrodes composed of the

rod member 6 is made of aluminum, and the connecting member 7 being in contact with the electrode foils 2 and 3. Furthermore, at the tip of the rod members 6, fixing outer connecting member 8 made from metal which is able to solder by means of weld and the like.

[0004]

Herewith, as electrolyte solution for driving the electrolytic capacitor having high conductivity, and to be impregnated to the capacitor element, wherein γ-butyrolactone is employed as the main solvent composed of quaternized cyclic amidin compounds (imidazolinium cation and imidazolium cation) as the cationic component and acid conjugated bases as the anionic component are dissolved therein as the solute (refer to the patent documents 1 and patent documents 2).

[0005]

[Patent documents 1] JP-H08-321440-A

[Patent documents 2] JP-H08-321441-A

[0006]

[Problem(s) to be Solved by the Invention]

However, due to the remarkable development of digital information devices in recent years, the high-speed driving frequency of micro-processor which is a heart of these electronic information devices is in progress. Accompanied by the increase in the power consumption of

electronic components in the peripheral circuits, the ripple current is increased abnormally, and there is a strong demand for the electrolytic capacitors used in these circuits to have a low impedance characteristic.

[0007]

Moreover, in the field of vehicles, with the recent tendency toward improved automobile functions, a low impedance characteristic is in high demand. By the way, the driving voltage of the vehicle circuit of 14V has been progressed to 42V accompanied by the increase in the power consumption. To comply with such a driving voltage, the electrolytic capacitor requires the withstand voltage characteristic of 28V and 84V and more. Furthermore, in this field, there is a demand of using high temperature, an electrolytic capacitor, high temperature life characteristic is required.

[0008]

However, in the aforementioned the electrolytic condenser, it could not respond to such a low impedance characteristic, and its limit withstand voltage was 30V. The electrolytic capacitor was able to respond to 28V but could not reply to the demand of high withstand voltage, such as 84V and more.

[0009]

The present invention aims to supply an electrolytic capacitor having an excellent high temperature characteristic, a low impedance characteristic, and a high withstand voltage characteristic of 100V class.

[0010]

[Means for Solving the Problem]

The present invention is characterized in that an electrolytic capacitor provide with a capacitor element formed by winding an anode electrode foil, a cathode electrode foil and a separator and by impregnating them with an electrolytic solution and an outer case housing the capacitor element and a sealing member housing an opening of the outer case, wherein an electrolytic solution containing an aluminum tetrafluoride salt is used as the electrolytic solution, and wherein a sealing member, a partial cross-linking peroxide butyl rubber that added peroxide as cross-linking agent to a butyl rubber polymer comprised of isobutylene, isoprene, and divinylbenzene copolymer.

[0011]

[Embodiment of the Invention]

The structure of the aluminium electrolytic capacitor has taken the same structure as the former, as shown in Fig. 1 and Fig. 2. The capacitor element 1 is formed by winding the anode electrode foil 2 and the cathode electrode foil 3 via the separator 11. As shown in Fig. 2, the anode electrode foil 2 and the cathode electrode foil 3 are connecting respectively

the lead wires 4 and 5 which are means for leading the anode and cathode electrodes 2 and 3. These lead wires 4 and 5 are composed of connecting member 7 being in contact with the electrode foils, and the rod members 6 continuing the connecting members7, and outer connecting members 8 having fixed the rod members 6. In addition, These lead wires are mechanically connected respectively to the electrode foils by means of stitching, ultrasonic welding, and the like.

[0012]

The anode electrode foil 2 is made of an aluminum foil of 99% and more purity in an acidic solution thereby enlarging the surface area thereof through the chemical or electrochemical etching process, and then subjecting the aluminum foil to a chemical treatment in an ammonium borate aqueous solution, an ammonium adipate aqueous solution, and the like, to thereby form an anode oxide film layer on the surface thereof.

[0013]

The capacitor element 1, which impregnates the electrolyte solution, is then housed into a bottomed outer case 10 made of aluminum. The outer case 10 is provided at the opening with a sealing member 9 and then sealed by drawing. The sealing member 9 has perforation holes through which the lead wires 4 and 5 are to be passed.

[0014]

Furthermore, as for first to third electrolytic capacitor of the present invention, a partial cross-linking peroxide butyl rubber that added peroxide as cross-linking agent to a butyl rubber polymer comprised of isobutylene, isoprene, and divinylbenzene copolymer is used as the sealing member. Examples of vulcanizing agents used in the vulcanization of peroxides include ketone peroxides, peroxy ketals, hydro-peroxides, dialkyl peroxides, diacyl peroxides, peroxy dicarbonates, peroxy esters, and the like. Specific examples are 1,1-bis-t-butylperoxy-3,3,5-trimethylcyclohexane, n-butyl-4,4-bis-t-butylperoxy-valerate, dicumyl peroxide, t-butyl-peroxy-benzoate, di-t-butyl-peroxide, benzoyl peroxide, 1,3-bis (t-butyl peroxy-isopropyl) benzene, 2,5-dimethyl-2,5-di-t-butylperoxyl-hexene-3, t-butyl peroxy cumene, α,α' bis (t-butylperoxy) diisopropylbenzene, and the like.

[0015]

The electrolysis solution for electrolytic condensers used for the present invention contains the aluminum tetrafluoride salt.

[0016]

As the aluminum tetrafluoride salt constituting the aluminum tetrafluoride as anion component, examples of this salt include an ammonium salt, an amine salt, a quaternary ammonium salt, or a quaternary cyclic amidinium ion as cation component, can be used. Examples of an amine constituting the amine salt include a primary amine

(such as methylamine, ethylamine, propylamine, butylamine, ethylenediamine, monoethanolamine, and the like); secondary amine (such as dimethylamine, diethylamine, dipropylamine, ethy-methylamine, diphenylamine, diethanolamine and the like); and tertiary amine (such as trimethylamine, triethylamine, tributylamine, 1,8-diazabicyclo[5,4,0] undecen-7, triethanolamine, and the like). Examples of a quaternary ammonium constituting the quaternary ammonium salt include a tetraalkylammonium (such as tetramethylammonium, tetraethylammonium, tetrapropylammonium, tetrabutylammonium, methyltriethylammonium, di-methyldiethylammonium and the like) and a pyridinium (such as 1-methylpyridinium, 1-ethylpyridinium, 1,3-diethylpyridinium and the like).

[0017]

Furthermore, as for salt containing the quaternized cyclic amidinium ion as a cationic component, the quaternized cyclic amidinium ion is a cation formed by quaternized a cyclic compound having an N,N,N'-substituted amidine group, and the following compounds are exemplified as the cyclic compound having an N,N,N'-substituted amidine group. They are an imidazole monocyclic compound (for example, an imidazole homologue, such as 1-methylimidazole, 1-phenylimidazole, 1,2-dimethyl-imidazole, 1-ethyl-2-methylimidazole, 2-ethyl-1-methylimidazole, 1,2-diethylimidazole, 1,2,4-trimethylimidazole and the like, an oxyalkyl derivative, such as

1-methyl-2-oxymethylimidazole, 1-methyl-2-oxyethyl-imidazole, and the like, a nitro derivative such as 1-methyl-4(5)-nitroimidazole, and the like, and an amino derivative such as 1,2-dimethyl-5(4)-aminoimidazole, and the like), a benzoimidazole compound (such as 1-methylbenzoimidazole, 1-methyl-2-benzylbenzoimidazole, 1-methyl-5(6)-nitrobenzo-imidazole and the like), a compound having a 2-imidazoline ring (such as 1-methylimidazoline, 1,2-dimethylimidazoline, 1,2,4-trimethylimidazoline, 1-methyl-2-phenylimidazoline, 1-ethyl-2-methylimidazoline, 1,4-dimethyl-2-ethyl-imidazoline, 1-methyl-2-ethoxymethylimidazoline, and the like), a compound having a tetrahydropyrimidine ring (such as 1-methyl-1,4,5,6-tetrahydropyrimidine, 1,2-dimethyl-1,4,5,6-tetrahydropyrimidine, 1,5-diazabicyclo[4,3,0]-nonene-5, and the like), and the like.

[0018]

As a solvent of the electrolytic capacitor utilized in the present invention, a polar protic solvent, an aprotic polar solvent, and their mixture thereof can be used. Examples of the polar protic solvent include monohydric alcohols (such as ethanol, propanol, butanol, pentanol, hexanol, cyclo-butanol, cyclo-pentanol, cyclo-hexanol, benzyl alcohol, and the like); and polyhydric alcohol and oxy alcohol compounds (such as ethylene glycol, propylene glycol, glycerine, methyl cellosolve, ethyle cellosolve, methoxy propylene glycol, dimethoxy propanol, and the like). Moreover, representative examples of the aprotic polar solvent include amide series

(such as N-methylformamide, N,N-dimethylformamide, N-ethylformamide, N,N-diethylformamide, N-methyl acetamide, N,N-dimethyl acetamide, N-ethyl acetamide, N,N-diethyl acetamide, hexamethylphosphoric amide, and the like); lactone compounds (such as γ-butyrolactone,δ-valerolactone, γ-valerolactone, and the like); sulfolane series (such as sulfolane, 3-methyl sulfolane, 2,4-dimethyl sulfolane, and the like); cyclic amide series (such as N-methyl-2-pyrrolidone, and the like); carbonate compounds (such as ethylene carbonate, propylene carbonate, isobutylene carbonate, and the like); nitrile compound (such as acetonitrile, and the like); sulfoxide series (such as dimethyl sulfoxide, and the like); 2-imidazolidinone series [for example, 1,3-dialkyl-2-imidazoridinone (such as 1,3-dimethyl-2-imidazoridinone, 1,3-diethyl-2-imidazoridinone, 1,3-di(n-propyl)-2-imidazoridinone, and the like); and 1,3,4-trialkyl-2-imidazoridinone (such as 1,3,4-trimethyl-2-imidazoridinone, and the like)], and the like. Among these, γ-butyrolactone is preferably used since an impedance characteristic will improve, sulfolane, 3-methyl sulfolane, and 2,4-dimethyl sulfolane are preferably used because of their excellent high temperature characteristics, and ethylene glycol is preferably used since withstand voltage characteristic will improve.

[0019]

According to the electrolytic capacitor of the present invention, a partial cross-linking peroxide butyl rubber that added peroxide as

cross-linking agent to a butyl rubber polymer comprised of isobutylene, isoprene, and divinylbenzene copolymer is used as the sealing member, and the electrolyte solution containing the aluminum tetrafluoride salt is used. The electrolytic capacitor of the present invention has a low impedance characteristic, and a high withstand voltage characteristic of 100V class. The high temperature life characteristic is improved further by the excellent high temperature characteristics of the electrolyte solution and the sealing member of the present invention.

[0020]

Moreover, the quaternary cyclic amidinium compound tends to cause leakage due to the reaction with the hydroxyl ion generated in the vicinity of the cathode leading means, however, the electrolyte solution used in the present invention seemingly has a less reactivity with the hydroxyl ion, and owing to the excellent sealability between the perforation hole of the sealing member and the lead wire, the leakage characteristic is further improved by these synergistic effects.

[0021]

[Embodiments]

Subsequently the present invention will be explained by using the embodiments. Since the structure of the electrolytic capacitor has taken the same structure as the former, it explains with reference to Fig. 1 and Fig. 2. A capacitor element 1 is formed by winding an anode electrode foil 2 and a cathode electrode foil 3 via a separator 11. As shown in Fig. 2, the anode electrode foil 2 and the cathode electrode foil 3 are connected respectively

to a lead wire 4 for leading the anode electrode and another lead wire 5 for leading the cathode electrode.

[0022]

These lead wires 4 and 5 are composed of connecting members 7 being in contact with the electrode foils, and the rod members 6 having been molded integrally with the connecting members 7, and outer connecting members 8 having been fixed at the tip of the rod members 6. The connecting member 7 and the rod member 6 are made from aluminum of 99% purity while the outer connecting member 8 is made of a copper-plated steel wire (hereinafter CP wire). On the surfaces of the rod members 6 of the lead wires 4 and 5 at least, anode oxide films made of aluminum oxide are formed by a chemical treatment with ammonium phosphate aqueous solution. These lead wires 4 and 5 are mechanically connected respectively to the electrode foils at the connecting members 7 by means of stitching, ultrasonic welding, and the like.

[0023]

The anode electrode foil 2 is made of an aluminum foil of 99.9% purity in an acidic solution thereby enlarging the surface area thereof through the chemical or electrochemical etching process, and then subjecting the aluminum foil to a chemical treatment in an ammonium adipate aqueous solution, to thereby form an anode oxide film on the surface thereof.

[0024]

The capacitor element 1, which impregnates the electrolyte solution, is then housed into the bottomed outer case 10 made of aluminum. The outer case10 is provided at the opening with the sealing member 9 and then sealed by drawing. The sealing member 9 has perforation holes through which the lead wires 4 and 5 are to be passed.

[0025]

Furthermore, as for first to third electrolytic capacitor of the present invention, a partial cross-linking peroxide butyl rubber that added peroxide as cross-linking agent to a butyl rubber polymer comprised of isobutylene, isoprene, and divinylbenzene copolymer is used as the sealing member. Examples of vulcanizing agents used in the vulcanization of peroxides include ketone peroxides, peroxy ketals, hydro-peroxides, dialkyl peroxides, diacyl peroxides, peroxy dicarbonates, peroxy esters, and the like. Specific examples are 1,1-bis-t-butylperoxy-3,3,5-trimethylcyclohexane, n-butyl-4,4-bis-t-butylperoxy-valerate, dicumyl peroxide, t-butyl-peroxy-benzoate, di-t-butyl-peroxide, benzoyl peroxide, 1,3-bis (t-butyl peroxy-isopropyl) benzene, 2,5-dimethyl-2,5-di-t-butylperoxyl-hexene-3, t-butyl peroxy cumene, α,α' bis (t-butylperoxy) diisopropylbenzene, and the like. As comparative example, a butyl rubber that vulcanized quinoid as cross-linking agent to a butyl rubber polymer comprised of the isobutylene and isoprene is used as

a sealing member.

[0026]

Furthermore, as an electrolyte solution A, wherein γ-butyrolactone (75 division) is employed as the solvent, and dissolved substance is 1-etyl-2,3-dimetylimidazolinium aluminum tetrafluoride salt(25 division) is used. As an electrolyte solution B, wherein γ-butyrolactone (80 division) is employed as the solvent, and dissolved substance is 1-etyl-2,3-dimetylimidazolinium aluminum tetrafluoride(20 division) is used. As comparative example, an electrolyte solution C, wherein γ-butyrolactone (75 division) is employed as the solvent, and dissolved substance is 1-etyl-2,3-dimetylimidazolinium phthalate compound is used.

[0027]

According to the electrolytic capacitor which were constructed by using the electrolyte solution of above embodiments, rated voltage of the electrolytic capacitors were that using the electrolyte solutions A, C are 16V, using the electrolyte solution B is 100V. The characteristics of the electrolytic capacitor were evaluated. The test conditions are 125℃ and 1,000 hours in the loaded state. The result are shown in (Table 1) to (Table 4).

[0028]

[Table 1]

	Electrolyte solution	Sealing member	Initial Characteristic		125℃—1000 hours load		Liquid leakage
			Cap (μF)	tanδ	ΔCap (%)	tanδ	
Embodiment 1	A	Peroxide	400	0.028	-7.6	0.034	0/25
Comparative example 1	A	Quinoid	401	0.028	-7.8	0.038	5/25
Comparative example 2	C	Peroxide	405	0.047	-6.1	0.060	0/25

[0029]

[Table 2]

	Electrolyte solution	Sealing member	Initial Characteristic		105℃—1000 hours no load		Liquid leakage
			Cap (μF)	tanδ	ΔCap (%)	tanδ	
Embodiment 1	A	Peroxide	400	0.028	-6.0	0.032	0/25
Comparative example 1	A	Quinoid	400	0.028	-6.6	0.036	7/25
Comparative example 2	C	Peroxide	400	0.028	-4.2	0.048	0/25

[0030]

[Table 3]

	Electrolyte solution	Sealing member	Initial Characteristic		125℃—1000 hours load		Liquid leakage
			Cap (μF)	tanδ	ΔCap (%)	tanδ	
Embodiment 2	B	Peroxide	22.8	0.011	-2.1	0.019	0/25

[0031]

[Table 4]

	Electrolyte solution	Sealing member	Initial Characteristic		105℃ — 1000 hours no load		Liquid leakage
			Cap (μF)	tanδ	ΔCap (%)	tanδ	
Embodiment 2	B	Peroxide	22.9	0.011	−0.9	0.014	0/25

[0032]

As shown in (Table 1) and (Table 2), the electrolytic capacitor of the embodiments has low tanδ compared with that of the comparative example, change of tanδ which is 125 ℃ is small, a high temperature life characteristic is excellent and the liquid leakage is also prevented. Furthermore, As (Table 3) and (Table 4) clearly shows, the initial characteristic is rated voltage 100V and the life characteristic is excellent. The electrolytic capacitor of the present invention, which has novelty, having a low impedance characteristic and high withstand voltage characteristic of 100V class is provided.

[0033]

[Effect of the Invention]

According to the present invention, an electrolytic capacitor, constructing a sealing member, a partial cross-linking peroxide butyl rubber that added peroxide as cross-linking agent to a butyl rubber polymer comprised of isobutylene, isoprene and

divinylbenzene copolymer is used. An electrolytic solution containing an aluminum tetrafluoride salt is used as the electrolytic solution is used. Such that the electrolytic capacitor having a low impedance characteristic and high withstand voltage characteristic, and excellent high temperature life characteristic and leakage characteristic are provided.

[Brief Description of the Drawings]

[Fig.1]

It is an internal sectional view showing the structure of an electrolytic capacitor.

[Fig. 2]

It is an exploded perspective view showing the structure of a capacitor element.

[Description of Notations]

1 Capacitor element

2 Anode electrode foil

3 Cathode electrode foil

4 The lead wire for anode electrode

5 The lead wire for cathode electrode

6 Rod member

7 Connecting member

8 Outer connecting member

9 Sealing member

10 Outer case

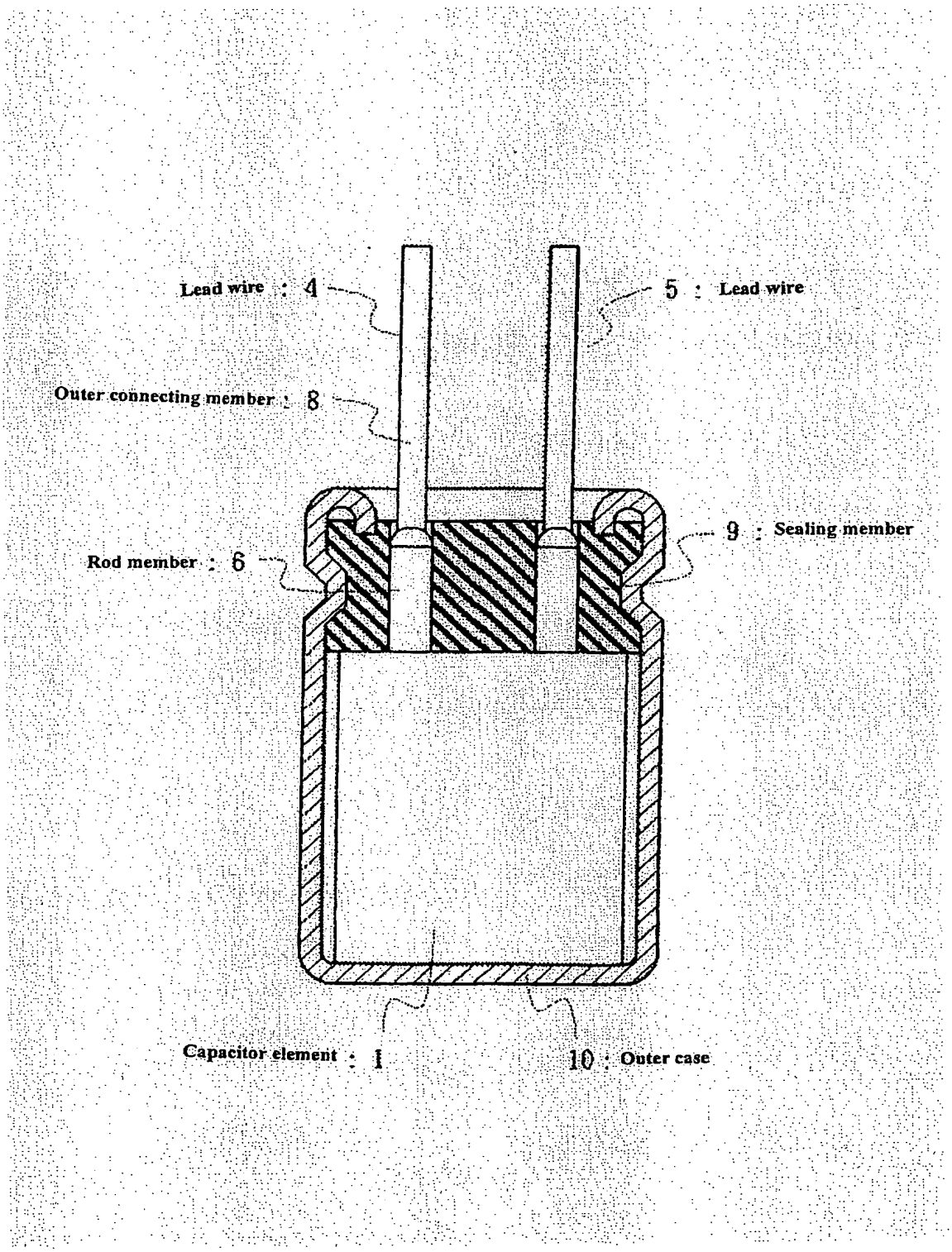
11 Separator

[Kind of Document] Drawings

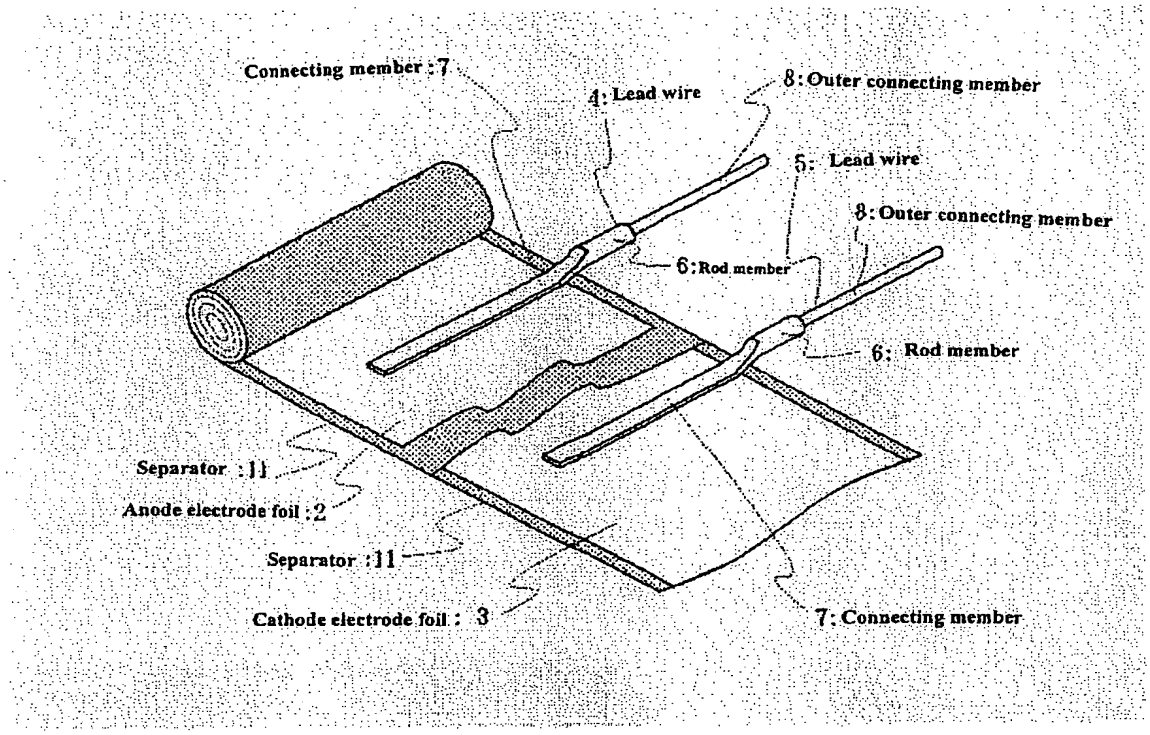
[Selected Drawing]

[Fig. 1]

Japanese patent application No. 2002-326019



[Fig. 2]


Connecting member :7
4: Lead wire
8: Outer connecting member
5: Lead wire
8: Outer connecting member
6: Rod member
6: Rod member
Separator :11
Anode electrode foil :2
Separator :11
Cathode electrode foil : 3
7: Connecting member

[Kind of Document] Abstract

[Abstract]

[PROBLEM TO BE SOLVED]

Electrolytic capacitor having a low impedance characteristic, having a high withstand voltage characteristic of 100V class, and a high temperature life characteristic is provided.

[SOLUTION]

An electrolytic capacitor, constructing a sealing member, a partial cross-linking peroxide butyl rubber that added peroxide as cross-linking agent to a butyl rubber polymer comprised of isobutylene, isoprene and divinylbenzene copolymer is used. An electrolytic solution containing an aluminum tetrafluoride salt is used as the electrolytic solution is used. Such that the electrolytic capacitor having a low impedance characteristic and high withstand voltage characteristic, and excellent high temperature life characteristic and leakage characteristic are provided.

[Selected drawings] Fig. 1

[Kind of Document] Abstract

[Abstract]

[Problem to be Solved]

Electrolyte solution for electrolytic capacitor and an electrolytic capacitor using it having a low impedance characteristic, having a high withstand voltage characteristic of 100V class, and a high temperature life characteristic is provided.

[Solution]

The electrolyte solution for electrolytic capacitor containing an aluminum tetrafluoride salt, and a solvent with high boiling point, such as sulfolane, 3-methyl sulfolane, and 2, 4-dimethyl sulfolane, and the like are used. The electrolytic capacitor of the present invention has the low impedance characteristic, the high withstand voltage characteristic, and the excellent high temperature life characteristic.

[Selected drawings] Nothing

[Kind of Document] Abstract

[Abstract]

[Problem to be Solved]

An electrolytic capacitor having a low impedance characteristic, having a high withstand voltage characteristic of 100V class, and a high temperature life characteristic is provided.

[Solution]

An electrolytic capacitor housing in an outer case a capacitor element formed by winding an anode electrode foil, a cathode electrode foil and a separator and by impregnating them with an electrolyte solution, wherein an electrolyte solution containing an aluminum tetrafluoride salt is used as the electrolyte solution, and wherein an electrode foil subjected to phosphate treatment is used as the anode and cathode electrode foils are used. The electrolytic capacitor having a low impedance characteristic and high withstand voltage characteristic, and excellent high temperature life characteristic is provided.

[Selected drawings] Nothing